MODEL ACE120X-XXX-XYZX
MODEL ACE130X-XXX-XYZX

User's Manual

Digital Velocity/Torque/Position Mode Servo Drive

This manual covers the use and maintenance of the models ACE120X and ACE130X series Torque, Velocity and Position mode brushless motor control product family.

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Installation and Operation

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1 ACE1000 Controller

1.1 Overview

This manual describes the installation and operation of the ACE1000 series of digital high voltage servo-amplifiers manufactured by ElectroCraft MI, Inc.

This document applies to serial numbers ending with xxxx 0109 and beyond.

The ACE1000 amplifier is:

- Configurable operation modes: Torque, Velocity, and Position.
- Selectable BLAC (sine wave, flux vector) or BLDC (Six step, trapezoidal) commutation.
- 4 Quadrant performance.
- Phase output, PWM controlled output.
- Full digital control of all loops
- Variable servo rate up to 10 kHz.
- Loop tuning via serial interface (No potentiometers!).
- Drive setup & status information available serially via RS232 link.
- 90 – 254 VAC Single or Three phase or 120-400 VDC input power supply range.
- Output current of 12 or 18 Amp continuous, 20 or 30 Amp peak, depending upon model selected.
- Compact package size.
- **ElectroCraft CompletePower™ Plus** graphical windows interface for Setup, Configuration and Tuning.

Software

For further documentation support of software and its usage, refer to the **ElectroCraft CompletePower™ Plus** software user's manual.

Parameters and Variables

For further documentation support of parameters, variables, commands and graphing refer to the ElectroCraft Parameter Guide.

2 ACE1000 Introduction

The term ACE1000 will be used throughout this manual to refer to all the ACE120x and 130x series family drives.

2.1 Amplifier

The ACE1000 is a fully digital servo amplifier that uses DSP technology to provide a powerful feature set that is fully configurable by means of a RS232 serial port. The ACE1000 servo drive is configurable as a Torque, Velocity, or Position mode servo amplifier. The ACE1000 is designed to operate a single 3 phase Brushed or Brushless DC or AC, permanent magnet motor. The motor may have either a WYE or Delta wound stator. The ACE1000 provides commutation using Hall sensors or encoder feedback.

The ACE1000 Torque, Velocity or Position modes accept serial, +/- 10 volt DC analog or digital PWM

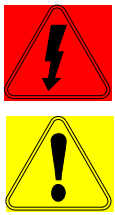
2.2 Theory of Operation

The ACE1000 operates as a "mode configurable" digital servo amplifier. This product is typically applied as a component within an end use industrial application. Within industry, application requirements for servo amplifiers vary widely. For example, one application may require an amplifier with an analog input reference for speed. Another application may require an amplifier that offers torque control and Hall sensor commutation only. For this reason the ACE1000 offers a choice of many different servo-operating modes. This flexibility is made possible because all of the control functions within the ACE1000 are implemented in software. The ACE1000 physical I/O and closed loop functionality are selected using the **ElectroCraft CompletePower™ Plus** software setup utility. See Section 8, Introduction to the **ElectroCraft CompletePower™ Plus** software, and the **ElectroCraft CompletePower™ Plus** software User Manual for additional information on using this software.

An internal digital signal processor (ASIC) is used to read I/O signals, motor feedback signals and to process serial communication messages. ROM memory inside the ACE1000 is used to store a library of modular software components. RAM memory is used for data logging and graphical tuning of the ACE1000. The serial EEPROM provides nonvolatile memory for retention of user-configured parameters and operating mode. EEPROM memory is also used to extend the program functionality of the ACE1000.

3 Product Safety Precautions

READ THIS ENTIRE SECTION BEFORE ATTEMPTING TO USE THE ACE SERVO DRIVE! GIVE SPECIAL ATTENTION TO ALL BOLD PRINT ITEMS.



WARNING!

THIS PRODUCT USES HIGH VOLTAGE ELECTRIC POWER AND POSES A SHOCK HAZARD TO THE USER.

To operate your control successfully, these minimum safety precautions MUST be followed to insure proper performance without injury to the operator and damage to motor or control. **FAILURE TO OBSERVE THESE SAFETY PRECAUTIONS COULD RESULT IN SERIOUS BODILY INJURY, INCLUDING DEATH IN EXTREME CASES.**

3.1 Operation

1. Do not touch any of the output connector pins from connectors P1, P2, or P6 when power has been applied. The voltages at these connector pins are dangerous and can produce an electric shock. Bare wires from adjacent connector pins must never be allowed to touch one another.

2. The ground stud, must be connected to an external earth ground. Follow wiring procedures carefully. Know and understand which connectors are NOT electrically isolated from the AC/DC voltages within the drive.

3. Always operate the control within the prescribed voltage limits. Any attempt to operate outside these bounds may result in damage to the unit.

4. Read ElectroCraft's Life Support Policy in Section 3.5 for application limitations.

5. Follow precautionary guidelines in this manual with regard to proper installation of an external shunt resistor. See Section 14 of this manual.

6. Do not operate the control in an explosive area or near explosive or flammable materials.

7. Do not use the control in environments where it is likely to be exposed to strong and/or frequent static discharge.

8. Conduct trial operations on the servo drive alone with the motor shaft disconnected from the machine to avoid any unexpected accidents. Motor shaft should be uncoupled and free to rotate without coming in contact with user or any stationary object during set up and preliminary operation.

9. Under no circumstances should a phase output from the control be connected to anything other than a passive inductive/resistive motor load. Short circuit protection for the drive is limited to momentary conditions only! Repetitive short circuits on any of the output pins for P6 will likely cause permanent damage to the ACE1000.

10. Never touch any moving parts while the motor is running. Failure to observe this warning may result in injury.

11. Excessive speed and current can destroy some motors and possibly injure the user. Check the motor manufacturer's specifications to ensure that the maximum current and voltage for your control model, does not exceed their limitations.

12. External methods are advisable to limit both the top speed and travel motion of the motor and its load. Whenever the ACE1000 drive is disabled for any reason, the motor is placed into a free/spinning coast mode.

13. When using the servomotor for a vertical axis, install safety devices to prevent work pieces from moving due to occurrences of over travel. Failure to do this may cause injury to work pieces or person.

14. Provide an appropriate stopping device on the machine side to ensure safety. A holding brake for a servomotor with brake is not a stopping device for ensuring safely. Failure to observe this warning may result in injury.

15. Do not parallel multiple motors off the same control.

16. Do not make any extreme adjustments or settings changes of parameters. Failure to observe this caution may result in injury due to instable operation.

17. Do not turn the control on or off frequently unless necessary. Failure to observe this caution may cause internal parts to deteriorate.

18. Avoid frequently plugging connector P1 into the control while live power is applied to the connecting cables. Ignoring this precaution will cause electrical arcing at the connector pins, which can cause permanent connector damage.

19. Do not remove the connectors on ports J5, J9, P1, P2, or P6 from the control while the motor is operating.

20. Do not remove the cover if one has been supplied. Each model has dangerous voltages on the circuit boards and may store a high voltage charge for several minutes after being disconnected.

21. Do not damage, press, exert excessive force or place heavy objects on the cables. Failure to observe this warning may result in electric stock, stopping operation of the product, or burning.

22. Do not service or modify this product. Only authorized personnel must perform disassembly or repair of the drive. Failure to observe warning may result in injury or damage to product.

23. To avoid a shock hazard always wait at least 5 minutes after disconnecting power from P1 before physically touching any internal circuits or external terminals. Residual voltage may cause electric shock. If necessary, use a functioning voltmeter to be certain that all high voltage capacitors inside the ACE1000 are fully discharged before physically touching internal circuits or external terminals.

3.2 Storage and Transportation

1. Do not store or install the product in the following place
    a. Locations subject to temperature outside of the range specified.
    b. Locations subject to humidity outside the range specified.
    c. Locations subject to condensation as the result of extreme changes in temperature.
    d. Locations subject to corrosive or flammable gases and liquids.
    e. Locations subject to dust, salts, or iron contaminants.
    f. Locations subject to exposure to water, oil, or chemicals.
    g. Locations subject to shock or vibration.

    Failure to observe this caution may result in fire, electric shock, damage to the product.

2. Do not hold the product by the cables or motor shaft while transporting it. Failure to observe this caution may result in injury or malfunction.
3. Store the ACE1000 drive when not in use, in temperatures between -20 to +85 degrees C.

3.3 Installation

1. Take appropriate and sufficient countermeasures when installing systems in the following locations.
    a. Locations subject to static electricity or other forms of noise.
    b. Locations subject to strong electromagnetic fields and magnetic fields.
    c. Locations subject to possible exposure to radioactivity.
    d. Locations close to power supplies including power lines.

    Failure to observe this caution may result in damage to the product.

2. Keep any external shunt resistor away from flammable materials. Read Section 14 carefully for more shunt installation details.

3. Never use this product in an environment subject to liquids, corrosive chemicals or gases, or combustibles, or where foreign materials are allowed to fall onto or collect inside the drive Failure to observe this caution may result in electric shock or fire.

4. Do not place heavy objects on the product. Failure to observe this warning may result in stopping operation of the product.

5. Do not cover or prevent air from escaping or entering through the vents with obstruction or foreign object. Failure to observe this caution may cause internal elements to deteriorate resulting in malfunction or fire.

6. Provide the specified clearance between the drive and the control panel or with other devices. Provide sufficient space around the drive for cooling by natural convection or provide cooling fans to prevent excessive heat, see Section 6.3 for details. Failure to observe this caution may result in fire or malfunction.

3.4 Wiring

1. Verify **ALL** wiring **BEFORE** applying power to the control and motor. Motor may spin or oscillate uncontrollably if improperly wired. Improper wiring may damage or prevent operation of drive.

2. **The ground P1, pin 1, MUST always be connected** to an appropriate external earth ground. There is also a chassis ground stud located on the ACE1000 chassis. This threaded ground stud must be electrically connected to an appropriate external earth ground.

3. Connect the ground terminal to the electrical codes (ground resistance should be less than 10 ohms. Improper grounding may result in electric shock or fire.

4. Do not connect a three-phase or any supply power to the U, V, and W terminals. Failure to observe this caution may result in injury or fire.

5. Securely connect the power supply terminals and motor output terminals. Failure to observe this caution may result in fire.

6. Do not bundle or run power and signal lines together in the same duct. Keep power and signal lines separated by at least 30cm.

7. Use twisted-pair shielded wires or multi-core twisted pair shielded wires for signal and encoder feedback lines.

8. Always use the specified power supply voltage. An incorrect voltage may result in burning. Be particularly careful where the power supply is unstable. An incorrect power supply may result in damage to the product.

9. Install external breakers or other safety devices against short-circuiting in external wiring. Failure to observe this caution may result in fire or damage to the control.

3.5 Life Support Policy

READ THIS ENTIRE SECTION BEFORE ATTEMPTING TO USE THE ACE1000 SERVO DRIVE! GIVE SPECIAL ATTENTION TO ALL BOLD PRINT ITEMS.

ElectroCraft's products are not authorized for use as critical components in life support devices or systems without the express written approval from ElectroCraft MI, Incorporated.

1. Life support devices or systems, are devices or systems which are intended for surgical implant into the body, or support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the User's Manual and in the labeling, can be reasonable expected to result in a significant injury to the user.

2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

4 Checking Product on Delivery

When your package arrives, inspect the shipping box and the unit carefully, and save ALL packing materials. Compare the packing slip against all items included in the shipping box. Any shortages or other inspection problems should be reported to ElectroCraft immediately.

The following procedure is used to check products upon delivery. Check the following items when your ACE1000 is delivered.

- Verify that the model number marked on the nameplate of the drive(s) is the correct model ordered.
- Check the overall appearance. Check for damage or scratches that may have occurred during shipping.

If there is any damage, or if the unit is the wrong type, contact your ElectroCraft sales representative immediately.

Your ACE1000 has arrived carefully packaged from ElectroCraft MI, in an antistatic bag. As you unseal this bag, inspect the contents carefully. There should not be any loose or damaged parts inside.

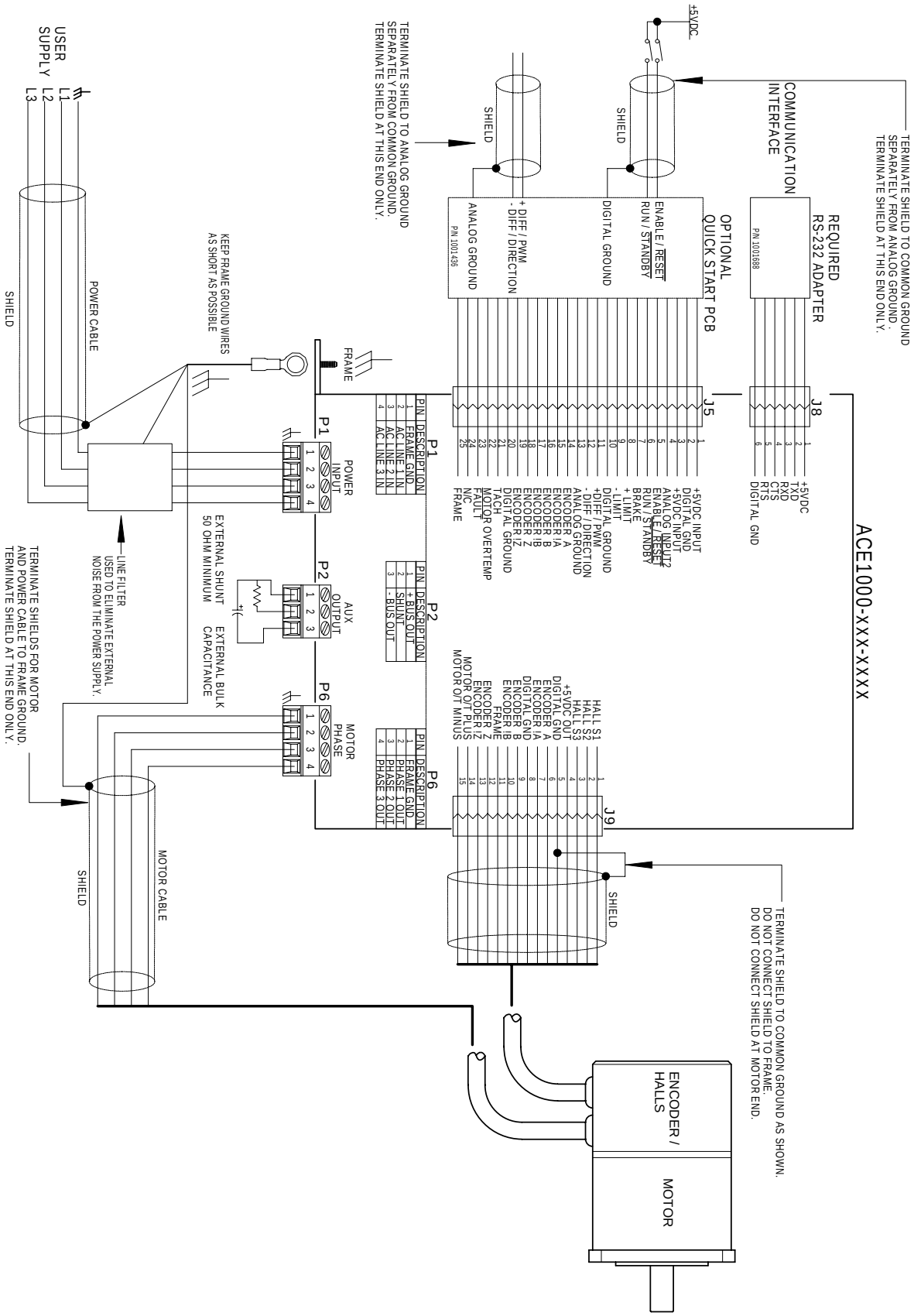
Never attempt to operate or power-up the drive if there is any visible external damage or if it sounds as though there are loose materials inside the chassis. While unpacking, if you discover any loose or damaged parts, notify ElectroCraft within two working days.

ElectroCraft recommends that all packing materials be saved in the event that the ACE1000 needs to be shipped back. Always place the ACE1000 in the same antistatic bag used in the original shipment. Abundant anti-static filler material should always be placed around the ACE1000 so that it cannot shift inside the box. Extreme care should be exercised when placing packing material around all external connectors to prevent mechanical stress damage.

All material to be returned to ElectroCraft must have a Return Material Authorization (RMA) tracking number assigned before shipment. This may be obtained by contacting the ElectroCraft Service Dept. Any product returned without this number will be rejected by ElectroCraft.

Always insure your shipment for the proper replacement value of its contents. ElectroCraft will not assume responsibility for any returned goods that have been damaged outside of our factory because of improper packaging or handling. All goods shipped to ElectroCraft must be shipped FREIGHT PREPAID.

5 Recommended Cabling and Installation



6 ACE1000 Installation and Setup

READ ENTIRE USER MANUAL FIRST BEFORE ATTEMPTING TO USE THIS PRODUCT.

If you require further assistance then provided within this manual, please email, call, or fax:

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This chapter presents installation procedures and instructions on how to setup your ACE1000 drive.

WARNING!

HIGH VOLTAGE MAY BE PRESENT AT THE P2 CONNECTOR.

If the user adds supplemental external capacitance via terminal P2, provisions should be made by the user to rapidly bleed this high voltage energy down to safe levels whenever the user's power source is disconnected from the system. Bleeder resistors are frequently used for this purpose. It will be necessary for the user to size this discharge method appropriately. The objective is to reduce the motor rail voltage down to safe levels (generally below +40 Volts DC) within an acceptable time period after the user's external power source is turned off or disconnected.

6.1 Mounting the ACE1000

Use this preferred hardware type, see table below, for mounting your ACE1000 drive. Mount your ACE1000 in the following manner.

Rack Mounted: Four M4/ No. 8 round head screws. Include spring (locking) washer with plain washer.

Weight: 5.98lb (2.71 Kg) with heatsink,
2.10Kg (4.62lb) with shipping plate.

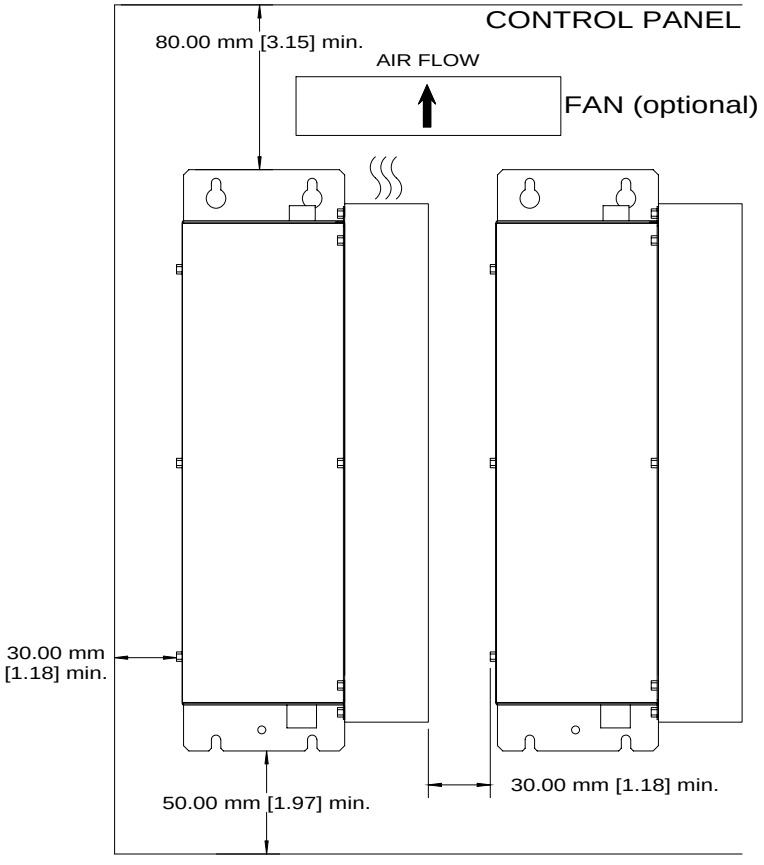
Size: 11.1" (282mm) x 6.7" (170mm) x 4.8" (122mm) with heatsink, or
11.1" (282mm) x 6.7" (170mm) x 3.2" (87mm) with shipping plate

6.2 Environmental Conditions in the Control Panel

- Storage Temperature: -20-85 degree C
- Humidity: 5-95%RH, Non-condensing
- Operating Temperature range: 0-50 degree C
- Vibration: Install a vibration isolator beneath the drive to avoid subjecting it to vibration.

6.3 Installation in the Control Panel

Install the ACE1000 perpendicular to the mounting surface.
When installing the ACE1000 side by side, provide at least 30 mm (1.18 in) between units or control panel, at least 80mm (3.15 in) above and 50 mm (1.97 in) below each drive. Install cooling fans above or below the drive to maintain a constant temperature inside the control panel and to prevent an excess temperature rise around the drive.



6.4 Simplified ACE1000 Internal Block Diagram

This following diagram is provided to familiarize the user with the internal architecture of the ACE1000. An internal digital signal processor (DSP) is used to read I/O signals, motor feedback signals and to process serial communication messages. ROM memory inside the ACE1000 is used to store a library of modular software components. RAM memory is used for data logging and graphical tuning of the ACE1000. The serial EEPROM provides nonvolatile memory for retention of user-configured parameters and operating mode. EEPROM memory is also used to extend the program functionality of the ACE1000.

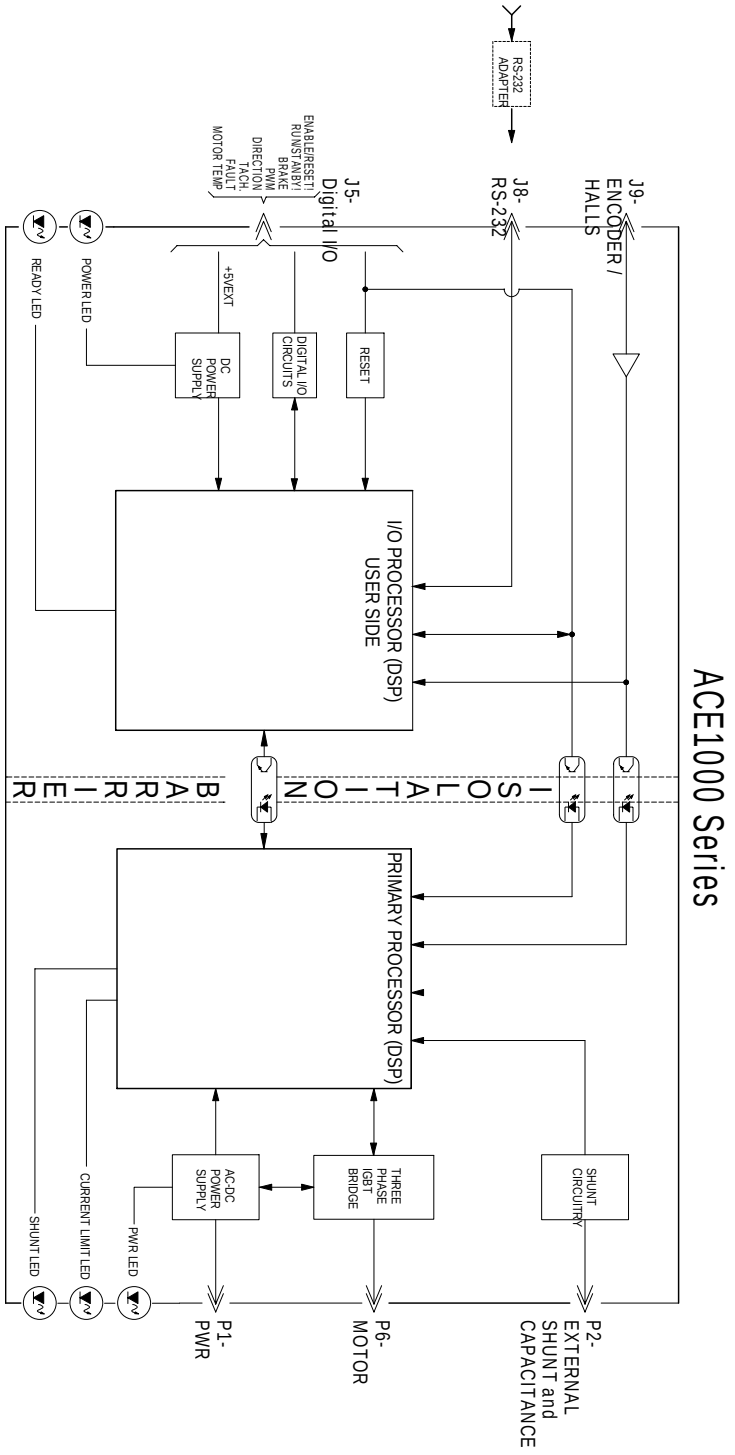


Figure 1: ACE1000 Block Diagram

6.5 ACE1000 Connector Description

Drive specific I/O operates independent of the user selected operating mode. Dive specific I/O signals have fixed functionality. These signals are used to interface the ACE1000 to an outside control system. They provide "hand shaking" signals for enabling, disabling, and monitoring the status of the ACE1000. For visual reference to the ACE1000 connectors, see Figure 2 below.

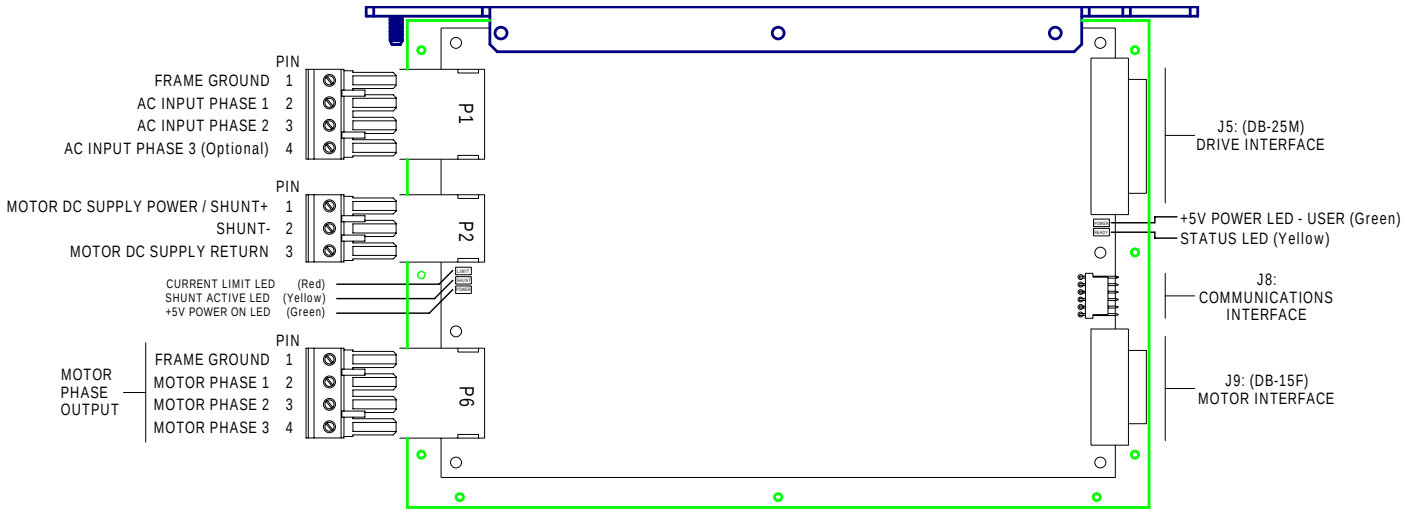


Figure 2: ACE1000 Connector Layout

6.5.1 J8 Connector: Communications Interface, 6-pin 2.54mm Header: *See note below.

Pin #	I/O	Description
1		Common Return
2	Output	RTS, 0-5V, non-buffered.
3	Input	CTS, 0-5V, non-buffered.
4	Input	RXD, 0-5V, non-buffered.
5	Output	TXD, 0-5V, non-buffered.
6		+5VDC.

*Requires ACE1000 RS-232 Adaptor cable (Part# 1001688) to be compatible with standard RS-232 communication ports.

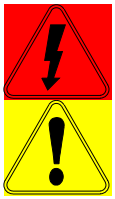
6.5.2 J5 Connector: User I/O Control, DB-25 plug with metal shell

Pin #	I/O	Description
1	Input	+ 5 volts DC Power. User supplied regulated +5VDC power.
2	Input	Common Return.
3	Input	+ 5 volts DC Power. User supplied regulated +5VDC power.
4	Input	Unipolar Analog Signal Input. 0 – 10 volt signal amplitude. +24 Volt max./ -0.5 Volt min.
5	Input	Enable/Reset Control Signal Input. TTL compatible. +24 VDC maximum signal amplitude. 0 Volts minimum. 10K Ohm input impedance. Positive true logic. Forces a master hardware reset for entire drive on a falling edge. Drive recovers beginning after rising edge. Drive remains disabled while a logic "0" is applied to this input. When Enabled (logic "1" applied), the active inrush current limit relay will close after a 3 second delay. After this delay, the drive will be allowed to enter Run Mode as commanded by the Run Command Signal Input on pin 6.
6	Input	Run Command Signal Input. TTL compatible. +24 VDC maximum signal amplitude. 0 Volts minimum. 10K Ohm input impedance. Positive true logic. A logic "1" state will allow motor commutation once some level of current is commanded. A logic "0" state places motor into a coast state.
7	Input	Dynamic Brake Command Signal Input. TTL compatible. +24 VDC maximum signal amplitude. 0 Volts minimum. 10K Ohm input impedance. Positive true logic. A logic "1" state will suspend motor commutation and current delivery from drive. It shorts all three motor phases together to cause the motor's BEMF to generate a dynamic braking torque within the motor.
8	Input	General Purpose Digital Input. TTL compatible. +24 VDC maximum signal amplitude. 0 Volts minimum. 10K Ohm input impedance. This input function is application specific. *Or* I2C Clock Input. 0V - +5V input signals
9	Input	General Purpose Digital Input. TTL compatible. +24 VDC maximum signal amplitude. 0 Volts minimum. 10K Ohm input impedance. This input function is application specific. *Or* I2C Data Input. 0V - +5V input signals
10		Common Return.
11	Input	Dual purpose Input. Software configured. + Differential Command Signal Analog Input. Zero to ±10 Volt external command signal input. The polarity of this signal controls the relative applied direction of output motor torque, velocity, or position. Input is protected to ±24 Volt maximum. *Or* PWM Control Input. Zero to +5 Volt logic signal. TTL compatible. +24 VDC maximum signal amplitude. 0 Volts minimum. 10K Ohm input impedance. Positive true logic. Weighting of PWM On-time Vs Off-time controls the amount of commanded torque, velocity, or position **NOTE: When using a single ended analog input signal to this input (rather**

		than a differential analog signal), pin 12 must be connected to the Analog Common, Pin 13.
12	Input	Dual purpose Input. Software configured. - Differential Command Signal Analog Input. Zero to ±10 Volt external command signal input. The polarity of this signal controls the relative applied direction of output motor torque, velocity, or position. Input is protected to ±24 Volt maximum. *Or* Direction Input. Zero to +5 Volt logic signal. TTL compatible. +24 VDC maximum signal amplitude. 0 Volts minimum. 10K Ohm input impedance. Selects relative direction of current flow into motor to control direction of applied torque, velocity, or position.
13		Analog Common.
14	Output	Encoder "A" Signal Output. Zero to +5 Volt logic signal.
15	Output	Encoder "!A" Signal Output. Zero to +5 Volt logic signal.
16	Output	Encoder "B" Signal Output. Zero to +5 Volt logic signal.
17	Output	Encoder "!B" Signal Output. Zero to +5 Volt logic signal.
18	Output	Encoder "Z" Marker Signal Output. Zero to +5 Volt logic signal.
19	Output	Encoder "!Z" Marker Signal Output. Zero to +5 Volt logic signal.
20		COMMON Return.
21	Output	Tachometer Signal Output. 250 Ohm output impedance. Zero to +5 Volt logic signal.
22	Output	Motor Overtemp Signal Output. 250 Ohm output impedance. Zero to +5 Volt logic signal. Positive true output signal. Logic "1" state indicates the motor is in an overtemp condition.
23	Output	!Fault Signal Output. 250 Ohm output impedance. Zero to +5 Volt logic signal. Negative true output signal. Logic "1" state indicates drive is NOT in a Fault mode.
24		No Connect
25		Frame Ground (OPTIONAL). Factory option to connect to servo drive frame. Its configuration for this purpose may violate certain safety agency requirements. Consult Automotion.
26		J1 Connector Frame. Connector shell is connected to servo frame ground.

6.5.3 J9 Connector: Motor Feedback, DB-15 Receptacle w/ metal shell

Pin #	I/O	Description
1	Input	Hall signal Input S1.
2	Input	Hall Signal Input S2.
3	Input	Hall Signal Input S3.
4	Output	+5 Volt DC Hall/Encoder supply voltage.
5	Output	Common Return.
6	Input	Encoder "A" Signal; zero to +5 Volt logic signal.
7	Input	Encoder "A!" Signal; zero to +5 Volt logic signal.
8	Output	Common Return.
9	Input	Encoder "B" Signal; zero to +5 Volt logic signal.
10	Input	Encoder "B!" Signal; zero to +5 Volt logic signal.
11	-	Factory Optional Servo Frame Ground. Normally this pin is not connected.
12	Input	Encoder "Z" Marker Signal; zero to +5 Volt logic signal.
13	Input	Encoder "Z!" Marker Signal; zero to +5 Volt logic signal.
14	Input	PTC/thermal switch contact for motor temp sensing.
15	Input	PTC/thermal switch contact for motor temp sensing.
Case	-	J2 Connector Frame. Connector shell is connected to servo frame ground.



WARNING!

THIS PRODUCT USES AN INTERNAL OR EXTERNAL SHUNT RESISTOR, PRECAUTIONS MUST BE FOLLOWED TO PREVENT A POSSIBLE FIRE HAZARD.

The connectors P1 and P2, shown below have **High Voltage** power applied to several of the associated pins. Use extreme care when making wire connections to them. All external electrical power should be OFF whenever wiring to these connectors to avoid a shock hazard. Refer to the Product Safety Precaution, Section 3.

The use of shunt resistor, either internal or external, requires careful placement to avoid a possible fire hazard. See Section 14 of this manual for further precautionary details

For information pertaining to mating connectors, refer to Section 8.

6.5.4 P1 Connector: AC/DC Power Input, Receptacle

Pin #	I/O	Description
1		Frame GROUND
2	AC/DC Input	90 to 254 VAC, 50/60 Hz, 1 Phase AC or ±120 to 400 Volts DC
3	AC/DC Input	90 to 254 VAC, 50/60 Hz, 1 Phase AC or ±120 to 400 Volts DC
4	AC/DC Input	90 to 254 VAC, 50/60 Hz, 1 Phase AC or ±120 to 400 Volts DC

6.5.5 P2 Connector: External Shunt Resistor or External Supplemental Capacitance, Receptacle

Pin #	I/O	Description
1	Output	+Bus Motor Rail. High Voltage DC positive rail for motor power. This terminal is used for connecting external supplemental capacitance and/or an external user supplied shunt resistor.
2	Output	Shunt Resistor. Connection for external user supplied shunt resistor. The other side of the external shunt resistor connects to terminal #1.
3	Output	-Bus Motor Rail. High Voltage DC negative rail for motor power. This terminal is used for connecting external supplemental capacitance supplied by user.

6.5.6 P6 Connector: Motor Phase Output, Receptacle

Pin #	I/O	Description
1		Frame GROUND
2	Output	Motor Phase 1 Output. Peak voltage out of this terminal is dependent upon the incoming crest voltage on connector P1. Peak amperage is model dependant.
3	Output	Motor Phase 2 Output. Peak voltage out of this terminal is dependent upon the incoming crest voltage on connector P1. Peak amperage is model dependant.
4	Output	Motor Phase 3 Output. Peak voltage out of this terminal is dependent upon the incoming crest voltage on connector P1. Peak amperage is model dependant.

7 ACE1000 Status LED's

In normal operation, the ACE1000 is either in a "Ready" state or in and "Error" state, meaning that one, or the other LED is on. If both LEDS are "ON", this indicates that the ACE1000 has been powered or reset with the Mode input floating. The Mode input is used to update ACE1000 program memory. See section 4, "Introduction to the *AutoMotionPLUS* software", and section 5, Working with the ACE1000-Helpful Notes and Procedures" for additional information.

7.1 User Ready "Status" LED (Yellow)

FLASH CODE	DESCRIPTION	POSSIBLE CAUSE	RESULT	RECOVERY METHOD
ON Steady	ACE1000 is in RUN mode.	User commanded RUN mode via user interface or serial communications port.	Clear all faults and STATUS flags Enable three-phase PWM	Toggle the DRIVE ENABLE signal
OFF	Processor is inoperable.	Drive is in reset Processor fault Improper user supplied +5Volts	ACE1000 will stay in a DISABLED mode Processor code branches to dead-end program loop in order to prevent any ACE1000 operation	Disconnect power from the ACE1000 for 1 min to reset the microprocessor. Then re-apply power to allow microprocessors to operate
1	Drive is in Standby mode	The user commanded standby mode from the user interface	The drive is placed in standby mode	Command run mode
2	Power Module Fault	Short circuit Over temp fault Improper power module logic control voltage	The drive is placed in standby mode	Toggle the run line, see Note 1
3	Shunt over stressed +Bus rail voltage to high	Shunt is turned on continuously for more than five seconds The B+ rail greater than fixed 450-Volt limit	The drive is placed in standby mode	Toggle the run line, see Note 1
4	+Bus rail to low	+Bus rail is less than the +Bus rail low limit	The drive is placed in standby mode	Toggle the run line, see Note 1
5	User +5volt Logic supply fault	User supplied SELV +5Volt out of spec. (4.75-5.25 Volts)	The drive is placed in standby mode	Toggle the run line, see Note 1 Check supply voltage
6	SPI communications timeout detected	DSP Lost SPI synchronization from communication processor	The drive is placed in the disabled mode. (hard fault)	Toggle the DRIVE ENABLE signal.
7	Locked rotor fault	Supplied current is greater than user specified time with no hall transitions	The drive is placed in standby mode	Toggle the run line, see Note 1
8	Logic supply fault	Line side logic power supplies out of spec (+/-15V and +5V)	The drive is placed in standby mode	Toggle the run line, see Note 1
9	EEPROM Fault Check sum fault	The user EEPROM has a checksum error DSP program memory error	The drive is placed in standby mode The drive is placed in disabled mode (hard fault)	Toggle the run line, see Note 1 Reprogram DSP, Warning: This will reset all drive parameters to default state
10	SPI communications timeout detected	Communication processor lost SPI communications from the DSP	The drive is placed in standby mode	Toggle the RUN line, see Note 1

Note: To toggle the run command, set the Run/! Standby signal logic '0' state for 100mS, then back to a logic '1'

7.2 User Power LED (Green)

LED	Description	Possible Cause	Result	Recovery Method
ON	+5 VDC Power Indicator	On if user power is on	Required to Run	N/A
OFF	+5 VDC Power Indicator	No user supplied +5 volts	Drive will not Run	Apply +5volts

7.3 Line Side Power LED (Green)

LED	Description	Possible Cause	Result	Recovery Method
ON	+5 VDC Power Indicator	Logic power is on	Required to Run	N/A
OFF	+5 VDC Power Indicator	Logic power is not on	Drive will not Run	Check AC power

7.4 Line Side Current Limit LED (Red)

LED	Description	Possible Cause	Result	Recovery Method
ON	Steady State	Drive in Reset		Toggle the DRIVE ENABLE signal
ON	During Power Up	Soft Charge (Relay Opened)		Allow 5 second power-up delay to allow internal capacitors to charge.
OFF		N/A	Soft Charge Complete (Relay Closed)	N/A
DIM	Flickering – Drive current limit	Current is sensed to be more than the calibrated drive capacity		N/A

7.5 Line Side Shunt Status LED (Yellow)

LED	Description	Possible Cause	Result	Recovery Method
ON		+Bus Rail is high, above the Shunt turn on limit of 437V	The shunt resistor is turned on	
OFF		+Bus Rail is below the shunt turn off limit of 425V	The shunt resistor is turned off	

8 Introduction to ElectroCraft CompletePower™ Plus Software

ElectroCraft CompletePower™ Plus is a Windows-based program used for setup, configuration, system diagnostics and motion control management. **ElectroCraft CompletePower™ Plus** will lead the user through a step-by-step Wizard to create the correct parameter configuration and information required for the user to run a particular motor with a particular drive. The result will be an "Application" containing all of the configuration information required to run the motor with the drive.

This section is described within the software user manual: **ElectroCraft CompletePower™ Plus** software users manual. Please refer to the software user's manual for full documentation support to properly configure and operate your drive.

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9 Recommended Minimum Hookup

Apply DC voltage to the Quick Start I/O interface:

a. J1 pin 1/2: +5VDC.
b. J1 pin 9/10: Common return

For additional information pertaining to the optional Quick Start I/O Board, refer to document: Quick Start User Guide.doc(x) located at the ElectroCraft web site.

9.1 Quick-Start I/O Test Interface Setup Diagram

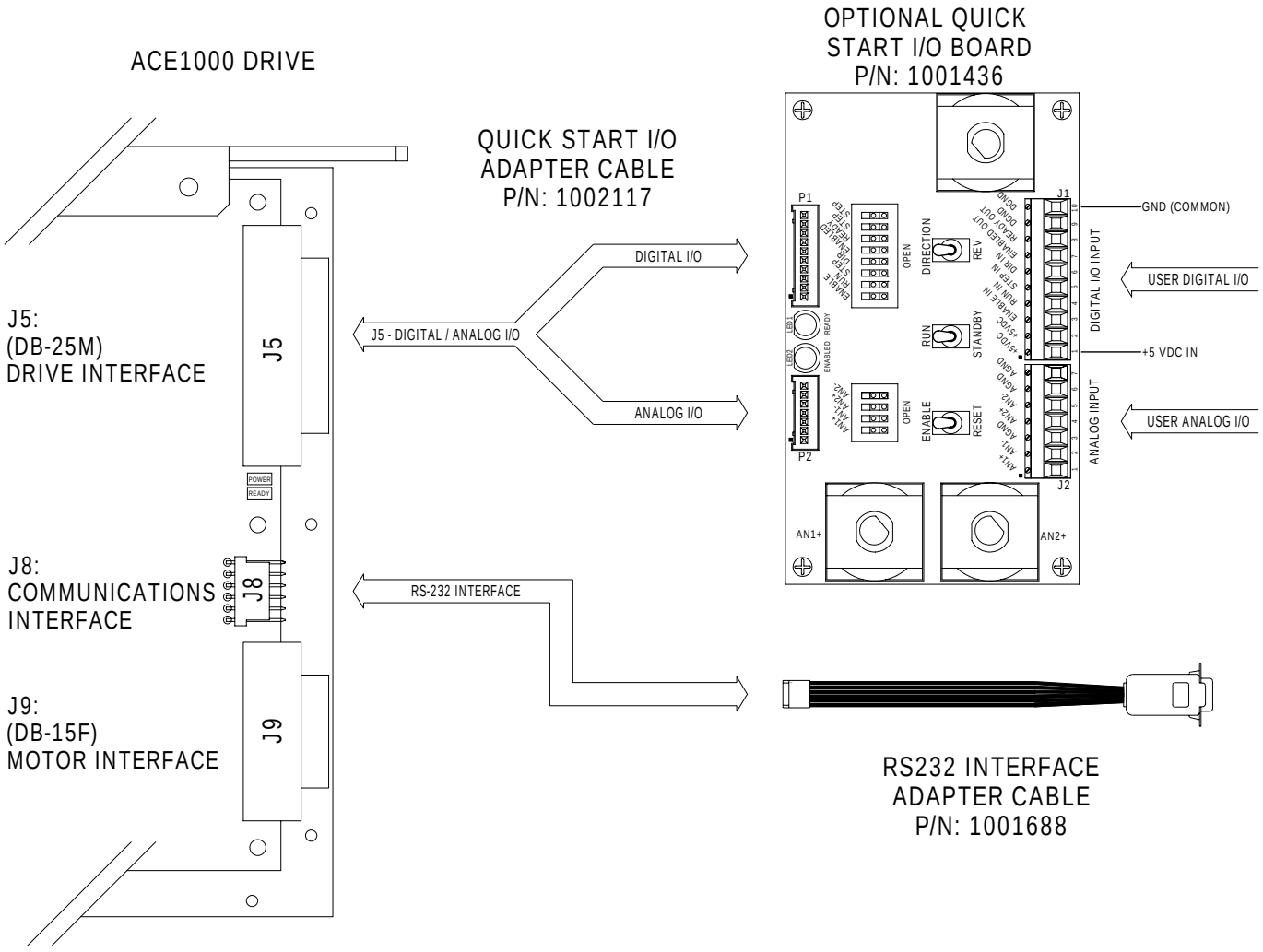

Figure 3: Optional Drive Setup

9.2 Wiring Diagrams for Optional User Interfaces

For mating connectors, see section 11.

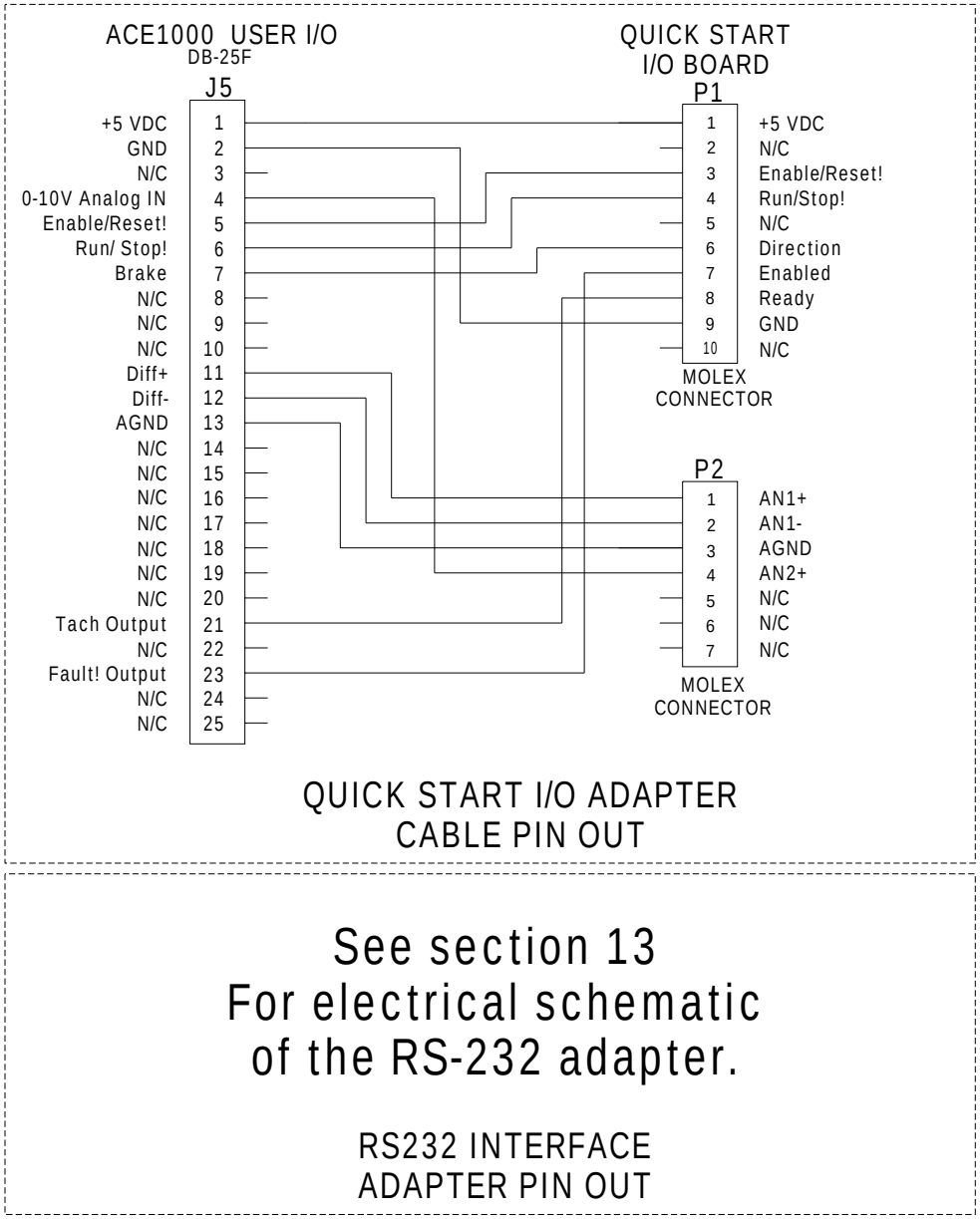

Figure 4: Optional Drive Setup wiring diagrams.

10 First Time Operation

10.1 Phasing the Motor

ElectroCraft has determined the correct motor phasing for all ElectroCraft motors. If your drive was ordered with an ElectroCraft motor specified, the correct parameter set for the mating ElectroCraft motor was loaded into your drive at the factory prior to shipment.

Alternate ElectroCraft motor parameters can be selected from the motor selection file on the software disk supplied with your drive, or you can contact ElectroCraft for these files.

In addition, ElectroCraft has established the correct motor phasing relationships for many other popular US and foreign motor manufacturers. A listing of these additional motor manufacturers may be obtained from ElectroCraft upon request.

10.2 Using ElectroCraft CompletePower™ Plus

To establish the correct motor phasing for a new or unknown motor ElectroCraft has provided a Windows based setup utility. Please refer to the **ElectroCraft CompletePower™ Plus** software user manual to setup your drive and analyze the performance of the drive as well as the motor.

Getting Started

To make use of this feature proceed as follows:

1. Install **ElectroCraft CompletePower™ Plus** software onto user PC.
2. Connect all motor phase and feedback wires to the drive.
3. Place drive into standby
4. Connect power and establish communications
5. Select “New application” to run the drive setup wizard. See **ElectroCraft CompletePower™ Plus** software user manual for detailed information.
6. The motor should now be properly phased for the ACE1000.

10.3 ACE1000 Model Specifications

Ratings at Temperatures = 0…50°C, (unless otherwise noted)

Parameter	Conditions	Value	Units
Supply			
Supply voltage	Nominal operating	100 to 240, 50 to 60Hz 120 to 400	VAC VDC
Supply current, surge	Inrush pulse duration <=100mS	-	A
Supply current, idle	No load condition.	-	mA
Supply current, operating		-	A
Over Voltage protection	Internal peak supply limited.	-	VAC
Reversed polarity withstand	Continuous; supply current externally limited to:		A
+5VDC User Supplied - regulation	Encoder Inputs, Hall Inputs and Digital I/O	4.75 to 5.25	V
+5VDC User Supplied - current required	Encoder Inputs, Hall Inputs and Digital I/O	250 minimum	mA
P6-Motor Outputs			
Output current, continuous	No additional heatsink	12 - 18	Arms
Output current, peak		20 - 30	A
Short circuit withstand	Phase-to-phase, phase-to-ground, phase to-supply threshold.	+/-	Amp
Short circuit protection delay		-	uS
On state voltage drop	Phase current = +/-5Amp	-	mV
Off-state leakage current	Phase Voltage = +/-48V.	-	uA
PWM frequency	Programmable, PWMPER	30	kHz
J5-Digital I/O Maximum Ratings			
Input voltage	All inputs (opto-isolated); referenced to +COM	-	V
Input current	All inputs (opto-isolated); referenced to +COM	-	mA
Output voltage	All outputs	-	V
Output current	All outputs	-	mA
Digital Inputs – J5			
On state voltage threshold	Referenced to +com	-	V
Off state voltage threshold	Referenced to +com	--	V
On state current	Input = -5V		mA
On state pulse width	Off voltage = 0V , On voltage = -3V	-	uS
Off state pulse width	On voltage = -5V , Off voltage = -1V	-	uS
Digital Outputs) – J5			
On state current	Referenced to +com	-	mA
On state voltage drop	On state current = 15 mA	-	V
Off state voltage	Sustained	-	V
Off state leakage current	Off state = 5.5V	-	uA
Analog Inputs – J5			
Input voltage Common-mode	Referenced to AGND	-	V
Input voltage differential	Nominal operating	-	V
Input impedance	Differential	-	K Ohm
Input impedance	Common mode, referenced to AGND	-	K Ohm
Analog ground current	Maximum AGND to GND	-	mA

ACE1000 Model Specifications, continued

Ratings at Temperatures = 0…50°C, (unless otherwise noted)

Parameter	Conditions	Value	Units
J9-Encoder Inputs			
Input voltage, Max.	Common-mode, referenced to ground	-25 to +25	V
Input voltage, Max.	Differential peak A to A , B to B , Z to Z	-30 to +30	V
Input voltage, differential	RS422 receiver, A to A , B to B , Z to Z operating.	-5 to +5	V
J9-Hall			
Input voltage range	Transient peak	-0.3 to +5.3	V
Low level voltage	Operating	0 to 1.8	V
Low level input current	Internal 1 K pull up to +5V	4 to 5	mA
Input hysteresis		0.2 to 0.5	V
Other			
Thermal resistance	Case to ambient	-	°C/W
Frame isolation voltage withstand	GND to Frame.	4000	VAC / Minute
Operating temperature	powered	0 to +50	°C
Storage temperature	Not powered	-20 to +85	°C
Humidity	Non-condensing	5 to 95	%RH
Weight		5.98 / 2.71	Lb./Kg

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11 ACE1000 Dimensional Drawing

Units: mm [in]

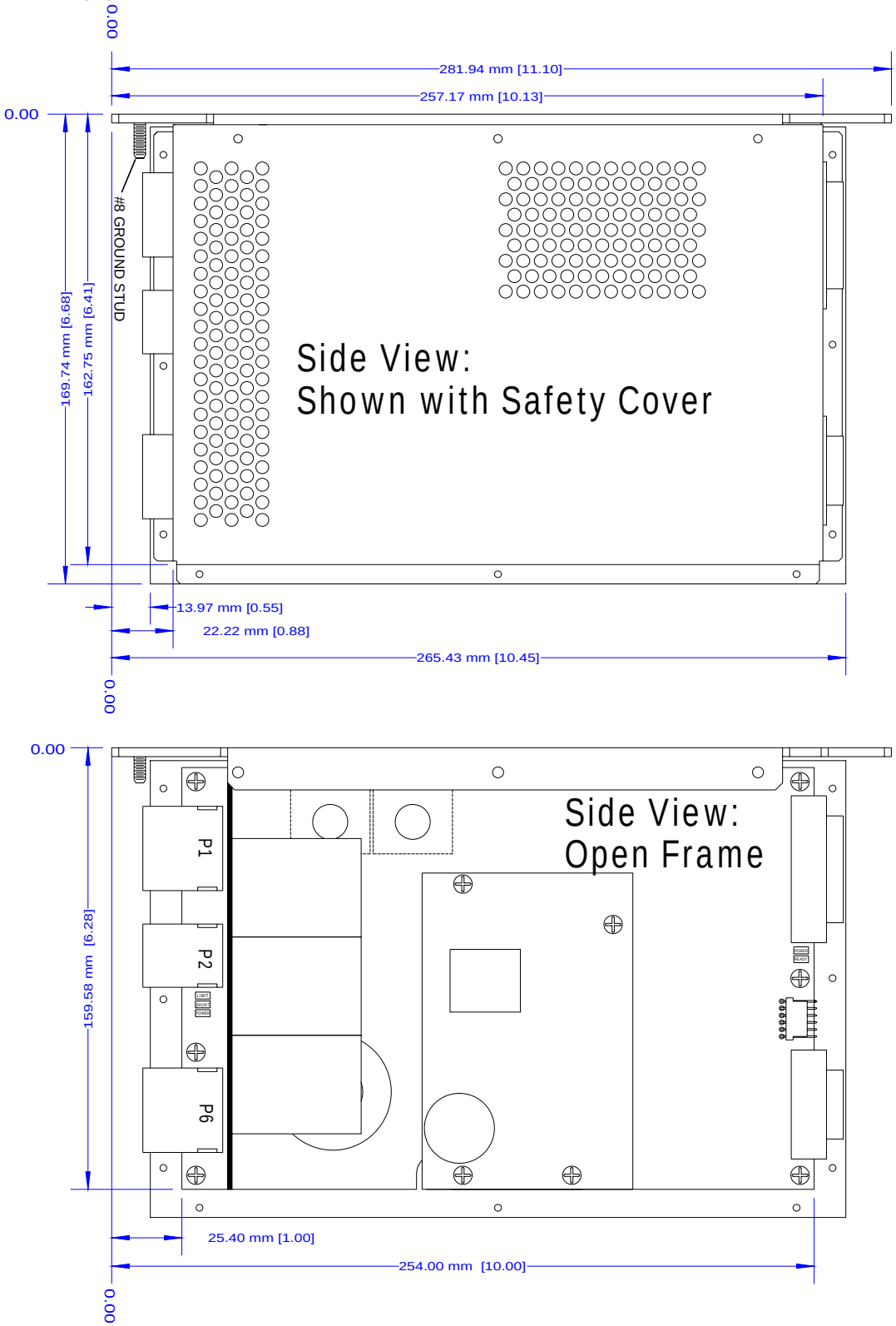

Figure 5: ACE1000 Package Outline – Side View

ACE1000 Dimensional Drawing, continued

Units: mm [in]

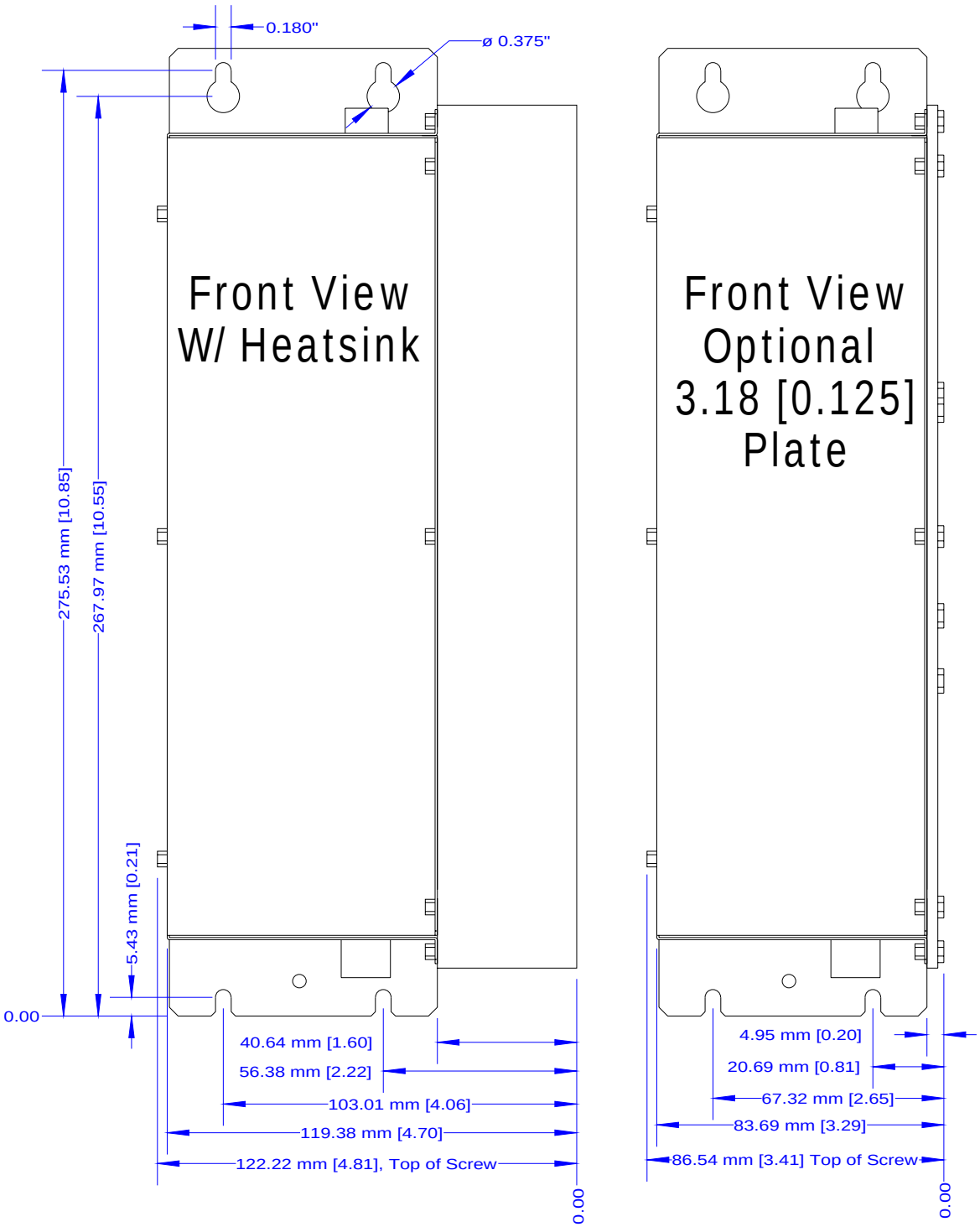

Figure 6: ACE1000 Package Outline – Front View

12 List of Mating Connectors

Ref.	Connector name	Manufacturer	P/N
P1	Power	Phoenix Contact	1804920
P2	Aux Capacitance & Shunt	Phoenix Contact	1804917
P6	Motor	Phoenix Contact	1804920
J5	Digital / Analog I/O	(Generic)	DB-25, Receptacle
J8	RS-232	Molex / Amp	35507-0600 / 770602-6
	Terminals - crimp	Molex / Amp	50212-8100 / 770666-2 (loose)
J9	Motor feedback	(Generic)	DB-15, Plug

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13 ACE1000 Interface Circuitry

13.1 J8: RS232 Communications Interface

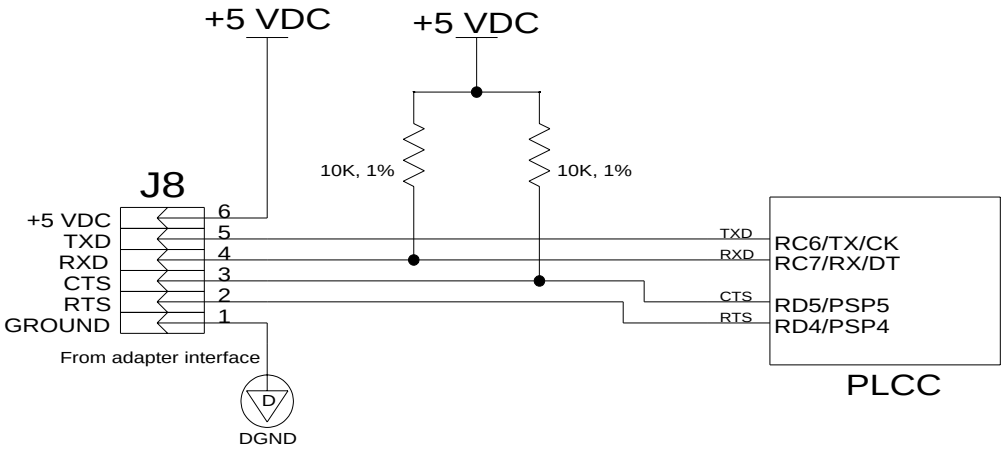


Figure 7: RS232 Communications Interface Circuitry

13.2 RS232 Communications Interface Adapter

From Section 9.2.

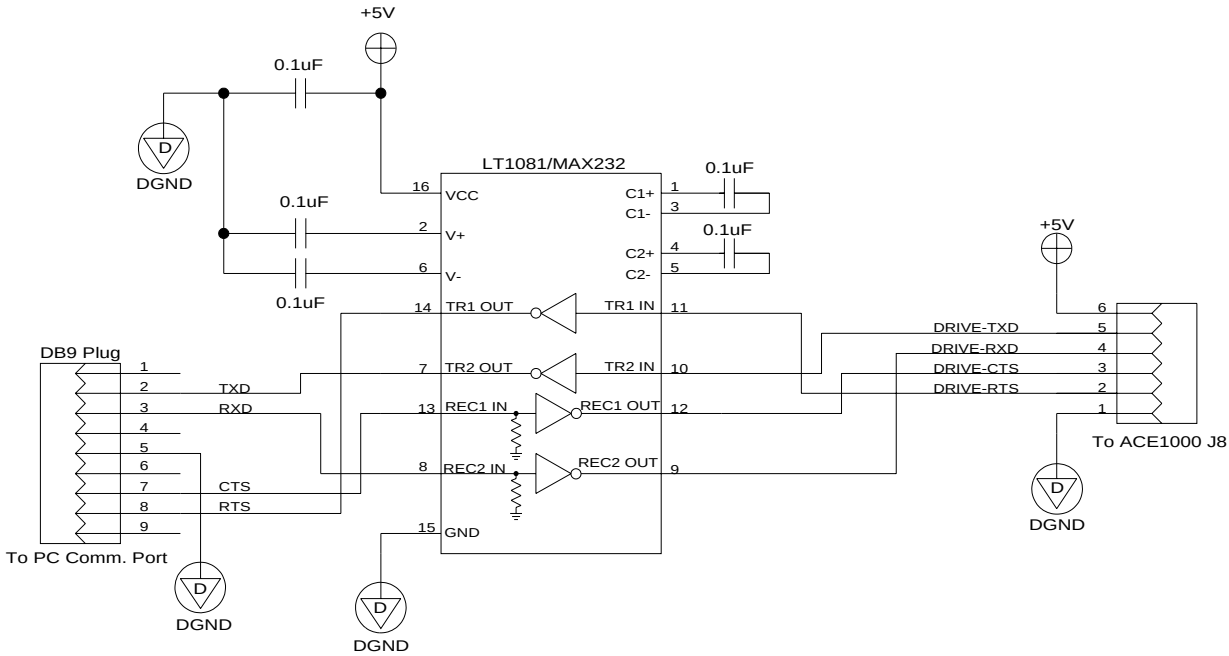


Figure 8: RS232 Communications Interface Adapter Circuitry

13.3 J5: Digital and Analog I/O

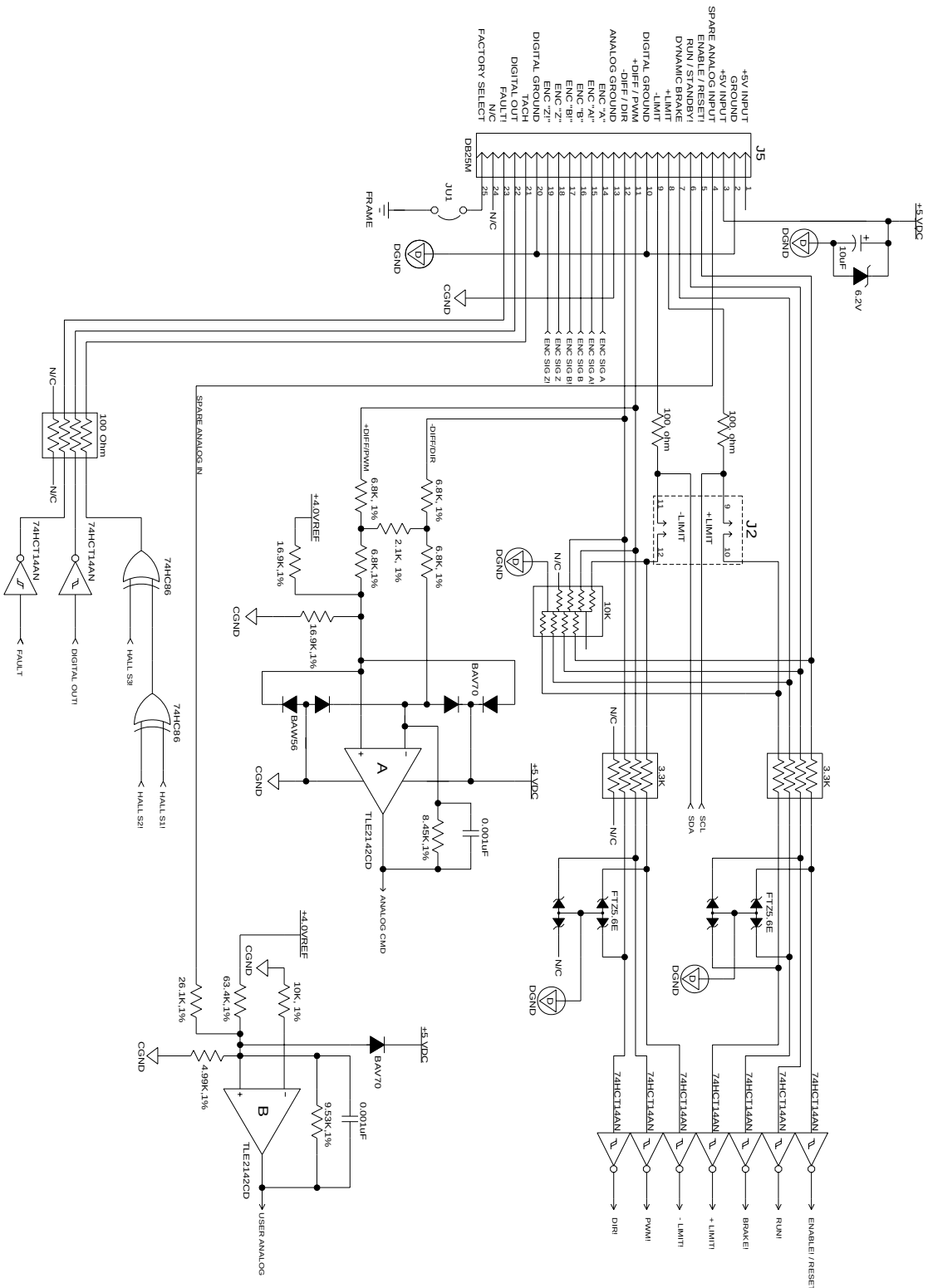


Figure 9: I/O Interface Circuitry

13.4 J9: Motor Interface

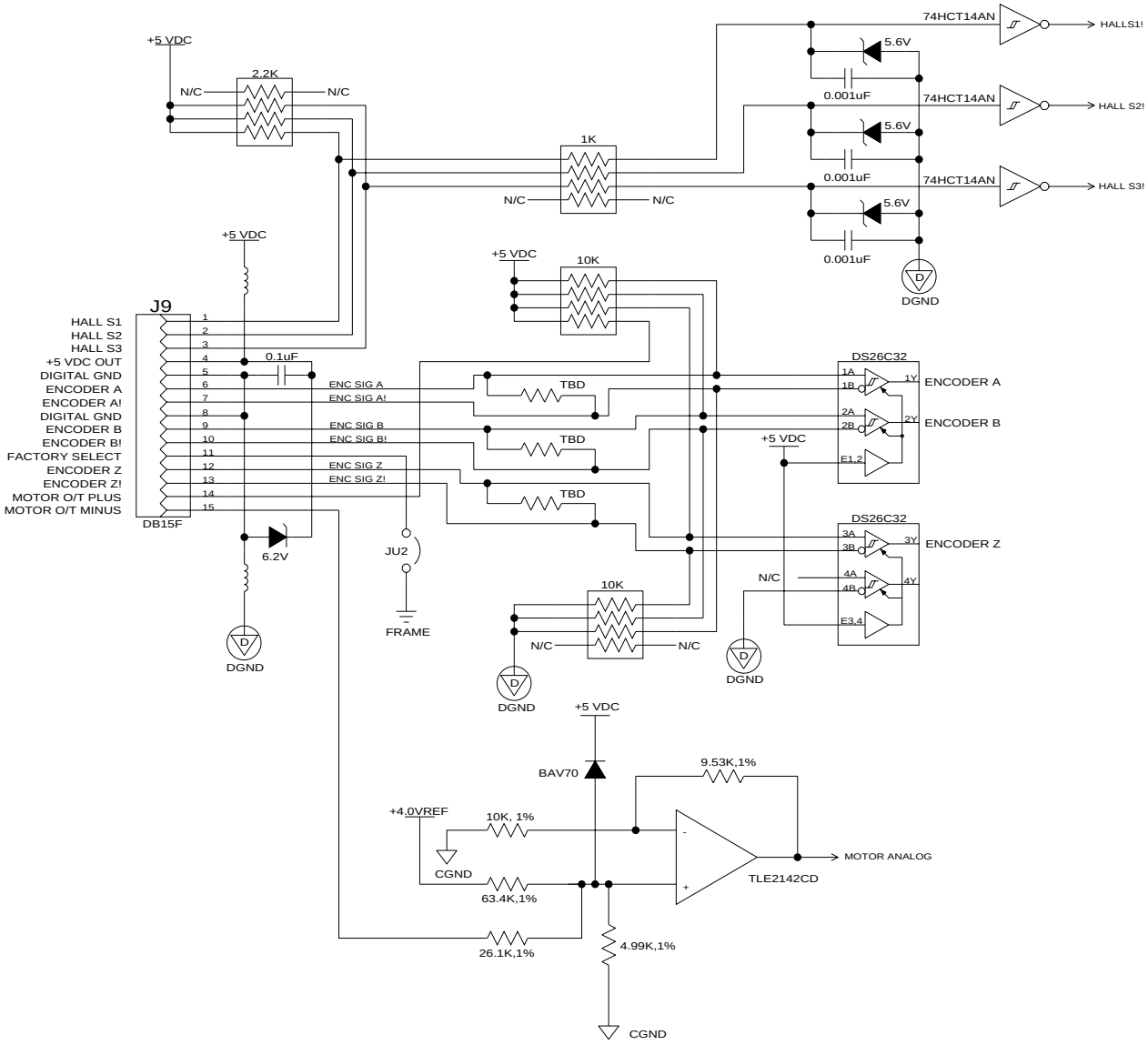


Figure 10: Motor Interface Circuitry

14 Internal Shunt

You're ACE1000 comes standard with an internal 110 watt / 50 ohm shunt. If additional wattage is needed then an external resistor will need to be purchased and installed by the customer. The internal shunt MUST be disconnected when using an external shunt. Please see the External Shunt Installation Procedure on the website or Consult ElectroCraft Sales for additional help. See recommendation below.

14.1 Use and Selection of the External Shunt via P2 Connector

CAUTION!

WHEN THIS PRODUCT USES AN EXTERNAL SHUNT RESISTOR PRECAUTIONS MUST BE FOLLOWED TO PREVENT A POSSIBLE FIRE HAZARD.

Never mount the external shunt resistor where it can make contact with flammable materials, flammable liquid and/or flammable chemicals. If the ACE1000 contains an optional shunt resistor mounted internal to the chassis, it too must be kept away from flammable materials, flammable liquid and/or flammable chemicals. Never use the ACE1000, either with or without a shunt resistor of any type, in an explosive atmosphere. Never place the shunt resistor in the proximity of flammable materials that could melt or drop upon the shunt resistor body or the ACE drive.

THIS PRODUCT USES HIGH VOLTAGE ELECTRIC POWER AND POSES A SHOCK HAZARD TO THE USER.

Shunt resistor(s) function using high voltage electric power. Avoid physical contact with them whenever the ACE1000 has power applied. Shunt resistor(s) can also become extremely hot. Follow the precautions stated below, and in conjunction with the manufactures precautions, to help prevent a fire hazard. The electrical terminals of shunt resistors are also a shock hazard. High voltage electricity is present on these terminals whenever the ACE1000 has power applied. A safety cover or shield is recommended to avoid a shock hazard.

In most applications when heavy dynamic braking and/or regenerative braking are involved, the ACE1000 will require an external shunt resistor.

The minimum permissible resistance value for the external shunt resistor(s) is 50 Ohms. If a lower resistance is required, consult ElectroCraft.

The external shunt resistor will connect to **connector P2** and must be wired across **terminals (1 and 2)**. Please refer to Section 6.5.5 for connector wiring.

- DO NOT CONNECT the shunt resistor across P2 terminals 1 and 3.
- DO NOT SHORT P2 terminals 1, 2 or 3 to frame ground.
- DO NOT USE a shunt resistor with a value less than 50 ohms. The resistor(s) should be rated for high momentary overloads.

It is important that the external shunt resistor be adequately sized to be reliable. It is also essential that this shunt resistor be located where it cannot cause a fire should it ever overheat. ElectroCraft recommends that the shunt resistor be placed in a well ventilated location and be kept away from flammable materials.

The shunt operates in conjunction with a transistor switch that places it across the motor high voltage rail. Should the transistor ever fail in the ON condition the resistor would remain powered continuously. This could result in the shunt resistor becoming very hot. A user-supplied heat shield may be required to limit a possible fire hazard.

The selected wattage rating for the shunt resistor is application dependent. Usually a heavy-duty wire wound resistor will work best. However, not all wire wound resistors are suitable for shunt service. ElectroCraft recommends using Isotek model ULH/ULV300N50 shunt: ElecrtoCraft part number 1001502:

- 300 watt / 50 ohm external shunt module.
- Non inductive windings, to isolate noise transients.
- Operating temperature range of -55 to 200°C.
- UL listed thermal protection (resettable fuse) set to 226°C.
- Dielectric strength of 1000v minimum.
- Wire lead length of 1000mm long.

See Isotek site page for additional information.

If the user is supplying their own shunt resistor contact ElectroCraft for further application advice. Ask for Field Application Bulletin #101-0195.

14.2 Dimensional Drawing Optional External Shunt

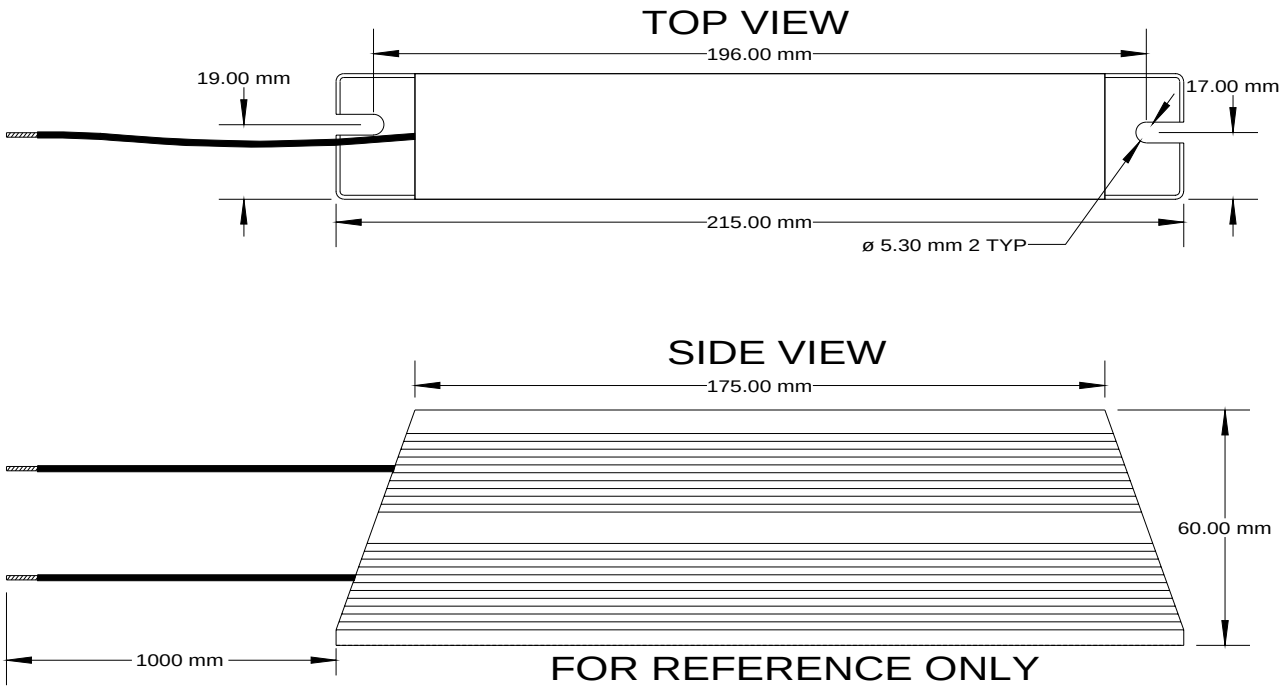
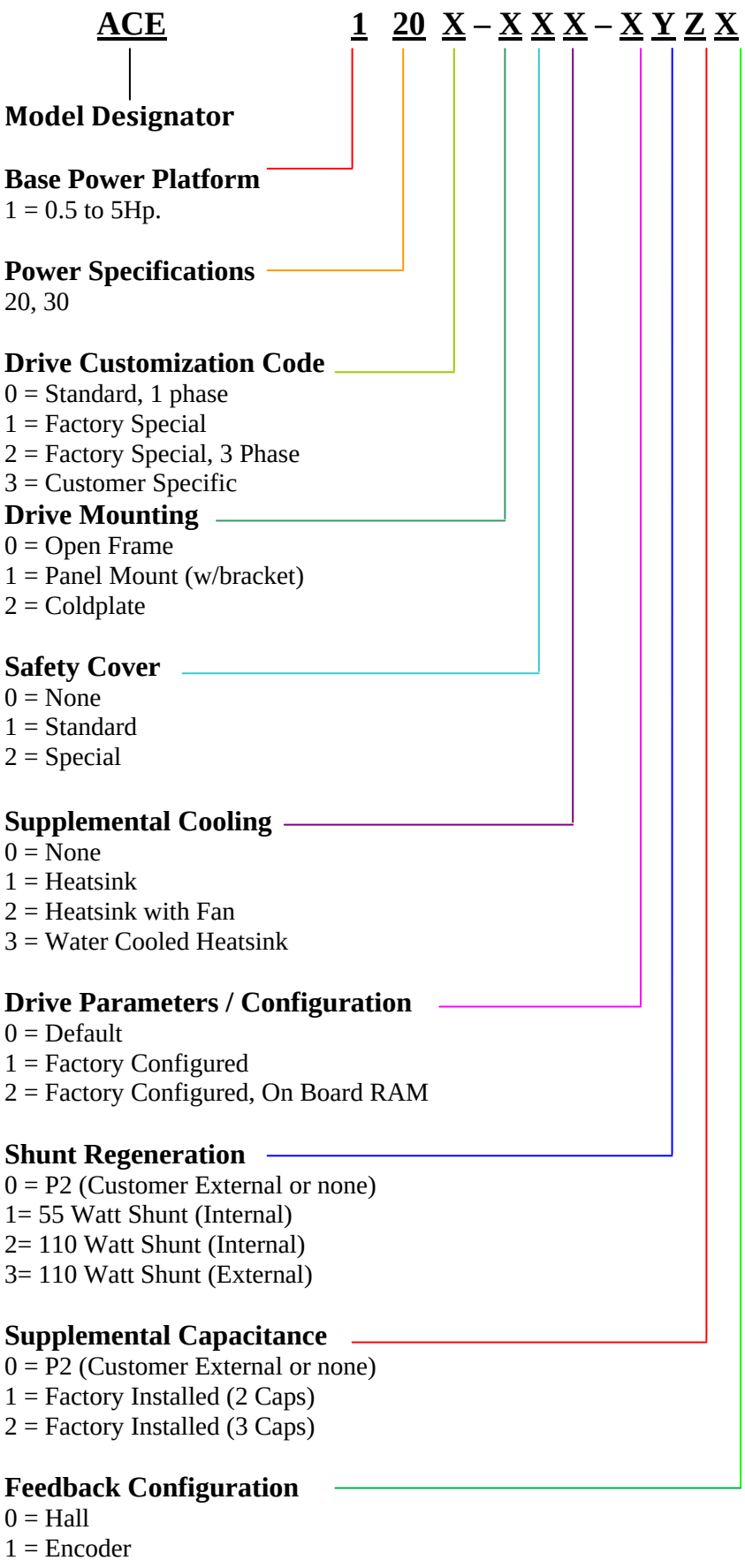


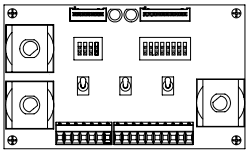
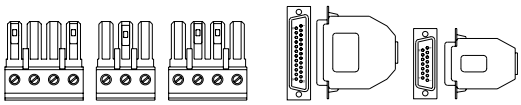
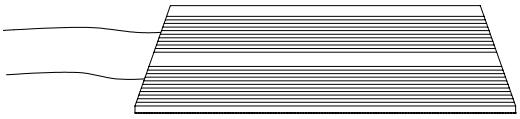
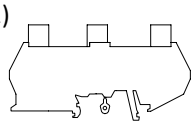
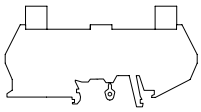
Figure 11: Isotek model ULV300 vertical mount

Note: Please visit the Isotek web site for current dimensional specifications.

15 Model Identification


ACE 1 20 X – X X X – X Y Z X
Model Designator
Base Power Platform
1 = 0.5 to 5Hp.
Power Specifications
20, 30
Drive Customization Code
0 = Standard, 1 phase
1 = Factory Special
2 = Factory Special, 3 Phase
3 = Customer Specific
Drive Mounting
0 = Open Frame
1 = Panel Mount (w/bracket)
2 = Coldplate
Safety Cover
0 = None
1 = Standard
2 = Special
Supplemental Cooling
0 = None
1 = Heatsink
2 = Heatsink with Fan
3 = Water Cooled Heatsink
Drive Parameters / Configuration
0 = Default
1 = Factory Configured
2 = Factory Configured, On Board RAM
Shunt Regeneration
0 = P2 (Customer External or none)
1= 55 Watt Shunt (Internal)
2= 110 Watt Shunt (Internal)
3= 110 Watt Shunt (External)
Supplemental Capacitance
0 = P2 (Customer External or none)
1 = Factory Installed (2 Caps)
2 = Factory Installed (3 Caps)
Feedback Configuration
0 = Hall
1 = Encoder

16 Appendix A - Optional Accessories

Name	Length inch (mm/m)	Description	Part No.	
Quick-Start I/O Test Board	n/a	Test Board 	1001436	1002994 (Set)
RS232 Interface Cable (Interface cable for PC)	7”	D-sub 9 pin Plug to ACE1000 J8.	1001688	
Quick Start to ACE1000 Adapter Cable	13”	D-sub 25 pin Plug ACE1000 J5 to Quick Start Test Board P1 and P2.	1002117	
Connector Kit	n/a	Mating connectors for P1, P2, P6, J5, and J9. 	1002105	
ACE Series External Shunt.	215 x 60 x 175mm (8.46 x 2.36 x 6.89”)	300 Watt (50 ohm) external shunt 	1001502	
Dual Encoder Assembly (Din Rail Mount)	46 x 90 x 48mm (1.8 x 3.6 x 1.9) (W x H x D)	Used when two encoder signals are supplied to the drive. (splits signals; 2 too 1) 	2000658	
R/D Converter Assembly (Din Rail Mount)	46 x 90 x 48mm (1.8 x 3.6 x 1.9) (W x H x D)	Used to create encoder or hall signals when a reslover is used. 	2000659	